We Claim:

1. A device for monitoring activity of carbon in a heat treating atmosphere comprising

a processor to generate a computed activity of carbon value for the gas atmosphere as a function of temperature, partial pressure of oxygen, and carbon monoxide content of the gas atmosphere, and without determining a carbon dioxide content of the gas atmosphere, and

an output terminal coupled to the processor to output the computed activity of carbon value.

2. A device according to claim 1

wherein the processor includes a comparator to compare the computed activity of carbon value to a selected set point and generate a deviation, and

further including an output for the deviation.

3. A device according to claim 2

wherein the output is coupled to a controller for the atmosphere.

4. A device according to claim 2 or 3

and further including an input for recording the selected set point from an operator.

5. A device according to claim 1

wherein the output is coupled to a device for displaying the computed activity of carbon value.

6. A device according to claim 1

wherein the output is coupled to a device for recording the computed activity of carbon value.

7. A device according to claim 1

and further including an input adapted to receive an electrical signal generated by at least one sensor indicating either the partial pressure of oxygen or the temperature of the atmosphere, and

wherein the processor processes the electrical signal to generate the computed activity of carbon value.

8. A device according to claim 1

and further including an input adapted to be coupled to a temperature sensor that generates an electrical signal that varies according to the temperature of the atmosphere, and

wherein the processor processes the electrical signal to generate the computed activity of carbon value.

9. A device according to claim 1

and further including an input adapted to be coupled to an oxygen sensor that generates an electrical signal that varies according to the temperature and partial pressure of oxygen of the atmosphere, and

wherein the processor processes the electrical signal to generate the computed activity of carbon value.

10. A device according to claim 1

wherein the processor also generates an oxidation alarm based upon the partial pressure of oxygen and temperature of the gas atmosphere.

11. A device according to claim 1

and further including an input coupled to the processor and adapted to receive an electrical signal that varies according to the carbon monoxide content of the gas atmosphere, and

wherein the processor processes the electrical signals to generate the computed activity of carbon value.

12. A device according to claim 11

wherein the electrical signal is generated based upon analysis of a gas atmosphere sample.

13. A device according to claim 11

wherein the electrical signal is set based upon a known carbon monoxide content.

14. A system for monitoring a gas heat treating atmosphere comprising

a processing element to derive a process

variable indicative of an activity of carbon value for the gas atmosphere derived from at least one sensor placed *in situ* in the gas atmosphere, and

an output for the process variable.

15. A system according to claim 14

wherein the output is coupled to a device that displays the process variable.

16. A system according to claim 14

wherein the output is coupled to a device that records the process variable.

17. A system according to claim 14

wherein the output is coupled to a device that generates the gas atmosphere.

18. A spherodize annealing system comprising

a heat treating furnace,

an atmosphere source for supplying a preselected gas atmosphere to the furnace,

a heat source to maintain the preselected gas atmosphere inside the furnace at a preselected temperature,

an oxygen sensor located *in situ* in the furnace in contact with the preselected gas atmosphere, the oxygen sensor providing a first electrical input that varies according to oxygen content of the preselected atmosphere,

a temperature sensor located *in situ* in the furnace in contact with the preselected gas atmosphere, the temperature sensor providing a second electrical input that varies according to temperature of the preselected atmosphere,

a processor to generate a computed activity of carbon value for the preselected atmosphere as a function of the first and second electrical inputs.

19. A system according to claim 18

and further including an output for the

computed activity of carbon value.

20. A system according to claim 19 wherein the output is coupled to a device for displaying the computed activity of carbon value.

21. A system according to claim 19 wherein the output is coupled to a device for recording the computed activity of carbon value.

22. A system according to claim 19 wherein the output is coupled to a controller for the atmosphere source.

23. A system according to claim 18 wherein the processor includes a comparator to compare the computed activity of carbon value to a selected set point and generate a deviation, and further including an output for the deviation.

24. A system according to claim 23 wherein the output is coupled to a controller for the atmosphere source.

25. A spherodize annealing system comprising a heat treating furnace,

an atmosphere source for generating a preselected gas atmosphere and supplying the preselected gas atmosphere to the furnace,

a heat source to heat the preselected gas atmosphere sufficiently to create a two phase region inside the furnace,

a processor to generate a computed activity of carbon value for the gas atmosphere as a function of temperature, partial pressure of oxygen, and carbon monoxide content of the gas atmosphere, and without determining a carbon dioxide content of the gas atmosphere,

an output terminal coupled to the processor to output the computed activity of carbon value, and

a controller coupled to the output terminal

and the atmosphere source to control generation of the gas atmosphere according to the computed activity of carbon value.

26. A system according to claim 25

wherein the processor includes a comparator to compare the computed activity of carbon output to a set point value and generate a control signal based upon the comparison,

wherein the output terminal outputs the control signal to the controller, and

wherein the controller controls generation of the gas atmosphere based upon the control signal.

27. A system according to claim 25

wherein the selected activity of carbon value varies as a function of temperature.

28. A method for monitoring a heat treating atmosphere comprising the steps of

generating a computed activity of carbon value of the heat treating atmosphere as a function of temperature, partial pressure of oxygen, and carbon monoxide content of the heat treating atmosphere, and without determining a carbon dioxide content of the heat treating atmosphere, and

using the computed activity of carbon value.

29. A method according to claim 28

wherein the using step includes controlling the heat treating atmosphere based, at least in part, upon the computed activity of carbon value.

30. A method according to claim 29

wherein the using step includes recording the computed activity of carbon value.

31. A method according to claim 29

wherein the using step includes displaying the computed activity of carbon value.

32. A method for monitoring a heat treating

atmosphere comprising the steps of

deriving from at least one sensor placed *in situ* in the heat treating atmosphere a process variable indicative of the activity of carbon in the heat treating atmosphere, and

using the process variable.

33. A method according to claim 32

wherein the using step includes controlling the heat treating atmosphere based, at least in part, upon the process variable.

34. A method according to claim 32

wherein the using step includes recording the process variable.

35. A method according to claim 32

wherein the using step includes displaying the process variable.

36. A method for performing spherodize annealing comprising the steps of

generating a gas atmosphere and supplying the gas atmosphere to a furnace,

heating the gas atmosphere in the furnace sufficiently to create a two phase region,

generating a computed activity of carbon value for the gas atmosphere as a function of temperature, partial pressure of oxygen, and carbon monoxide content of the gas atmosphere, and without determining a carbon dioxide content of the gas atmosphere, and

controlling the gas atmosphere according to the computed activity of carbon value.

37. A method according to claim 36

and further including the step of comparing the computed activity of carbon output to a selected activity of carbon value and generate a control signal based upon the comparison, and

wherein control step controls the gas

atmosphere based upon the control signal.

38. A method according to claim 37

wherein the selected activity of carbon value varies as a function of temperature.

39. A method for performing spherodize annealing comprising the steps of

generating a gas atmosphere and supplying the gas atmosphere to a furnace,

heating the gas atmosphere in the furnace sufficiently to create a two phase region,

sensing oxygen content with an oxygen sensor placed in situ in the furnace to provide a first electrical output that varies according to oxygen content of the gas atmosphere,

sensing temperature with a temperature sensor placed in situ in the furnace to provide a second electrical output that varies with temperature,

computing an activity of carbon value based upon the first and second electrical outputs, and

controlling the gas atmosphere according to the computed activity of carbon value.

40. A method according to claim 39

and further including the step of comparing the computed activity of carbon to a selected activity of carbon value and generate a control signal based upon the comparison, and

wherein control step controls the gas atmosphere based upon the control signal.

41. A method according to claim 40

wherein the selected activity of carbon value varies as a function of temperature.

42. A method for determining a partial pressure of carbon monoxide in a gas atmosphere comprising a mixture of nitrogen and either an endothermic atmosphere or methanol, the method comprising

the steps of

supplying the gas atmosphere at a fixed flow rate into a furnace,

deriving from an oxygen sensor placed in situ in the furnace a sensed partial pressure of oxygen in the furnace,

deriving from a temperature sensor placed in situ in the furnace a sensed temperature in the furnace,

deriving, without using a carbon monoxide sensor outside the furnace, a partial pressure of carbon monoxide as a function of the sensed partial pressure of oxygen and the sensed temperature.